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Yamagami et al.

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[54] **ELECTRICAL CONNECTOR**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[6] **H01R 13/62**

[52] **U.S. Cl.** **439/326**

[58] **Field of Search** 439/326, 327, 439/328, 296

[56] **References Cited**

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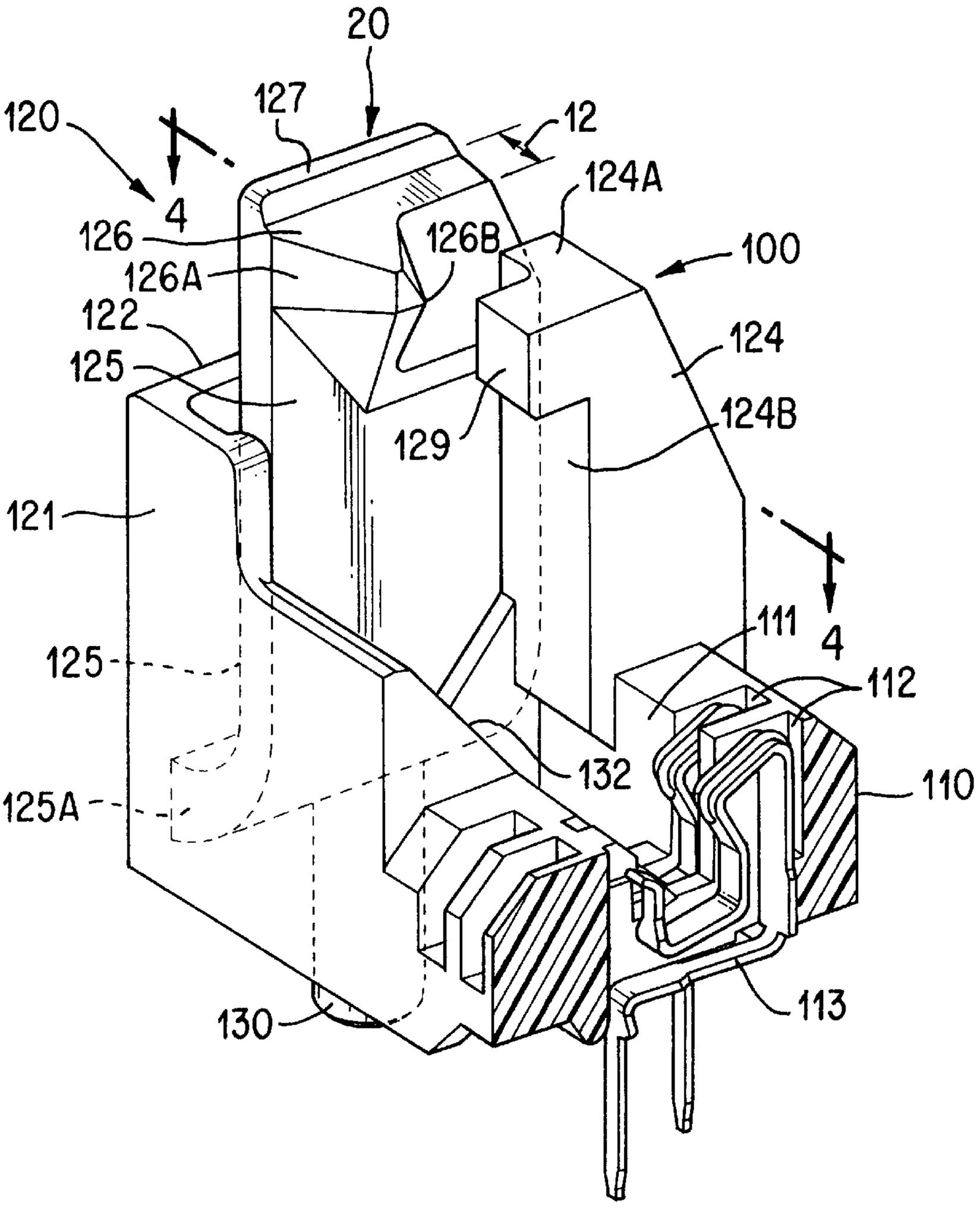
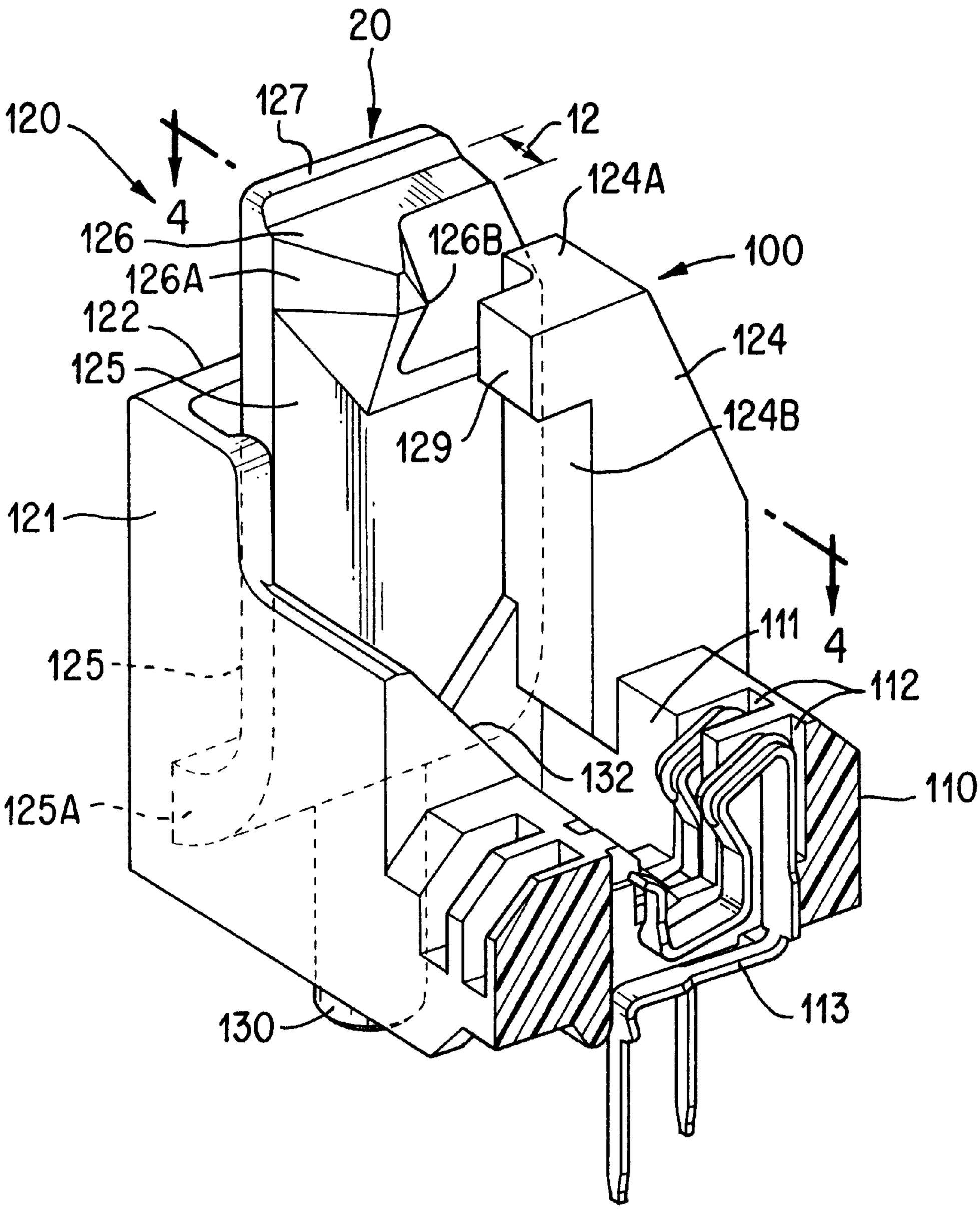
Primary Examiner—Steven L. Stephan
Assistant Examiner—Eugene G. Byrd
Attorney, Agent, or Firm—Kanesaka & Takeuchi

[57] **ABSTRACT**

An electrical connector includes a board latch which has an L-shaped engaging arm for latching a board. The outside face of a free end of the engaging arm is flush with the outside face of a vertical portion of the engaging arm. A ridge is provided on the engaging arm for positioning the board in the longitudinal direction of a board receiving slot.

12 Claims, 12 Drawing Sheets




20
127
120
12
4
124A
126
126B
100
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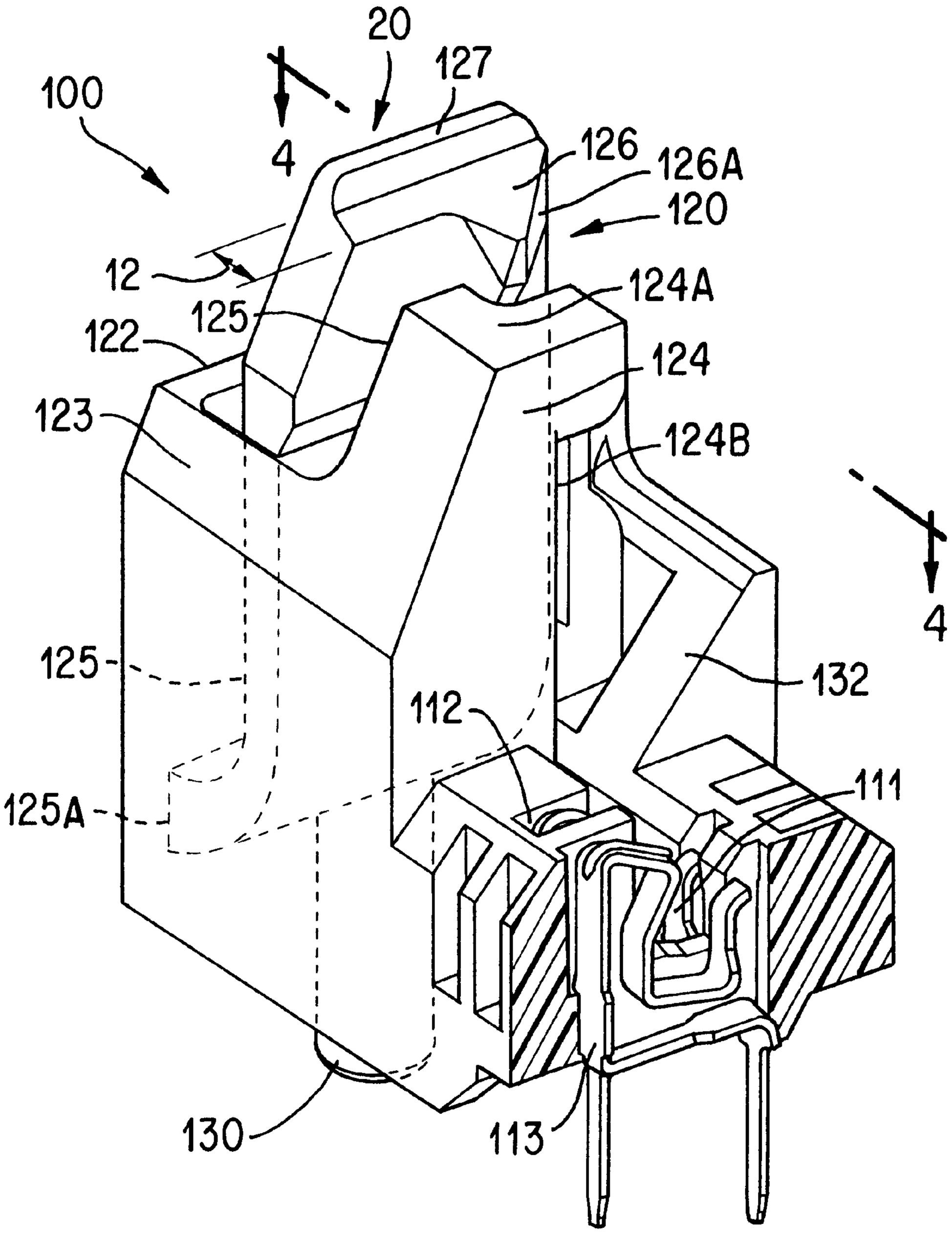
122
124
125
129
124B
121
111
4
125
112
132
110
125A
130
113

FIG.1


20
127
100
4
126
126A
120
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124B
4
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132
112
111
125A
130
113

FIG. 2

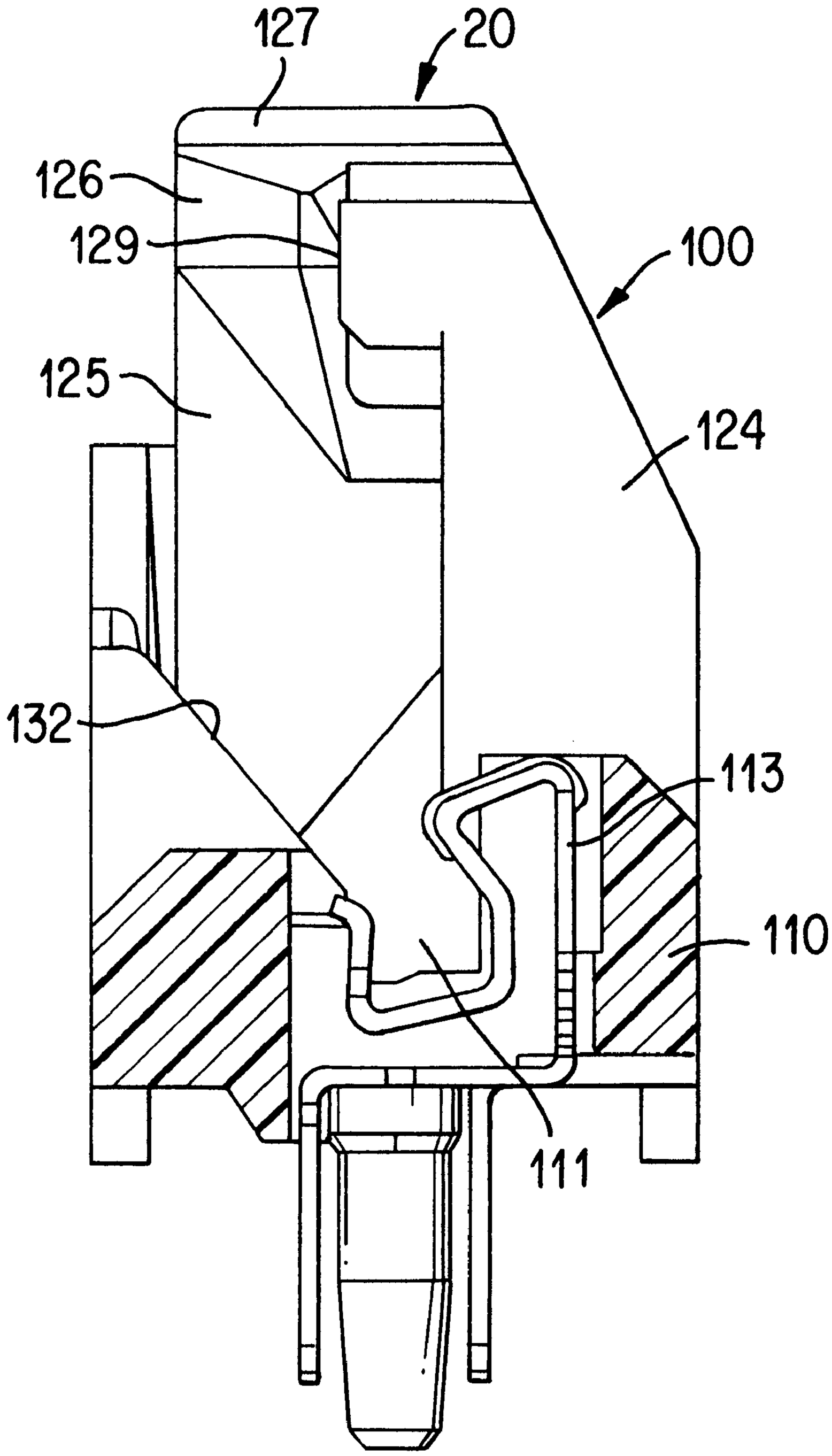

FIG. 3

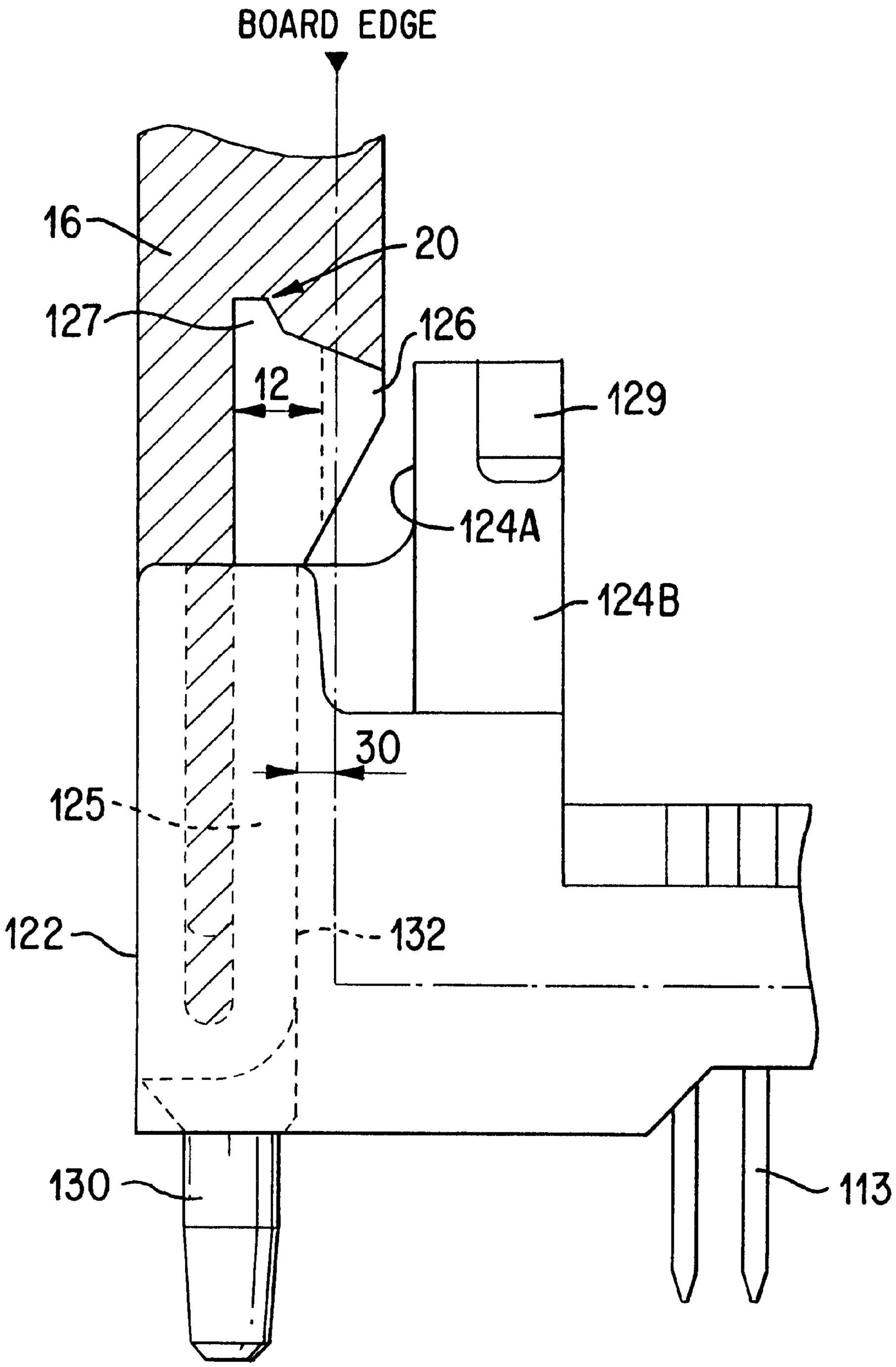

FIG. 4

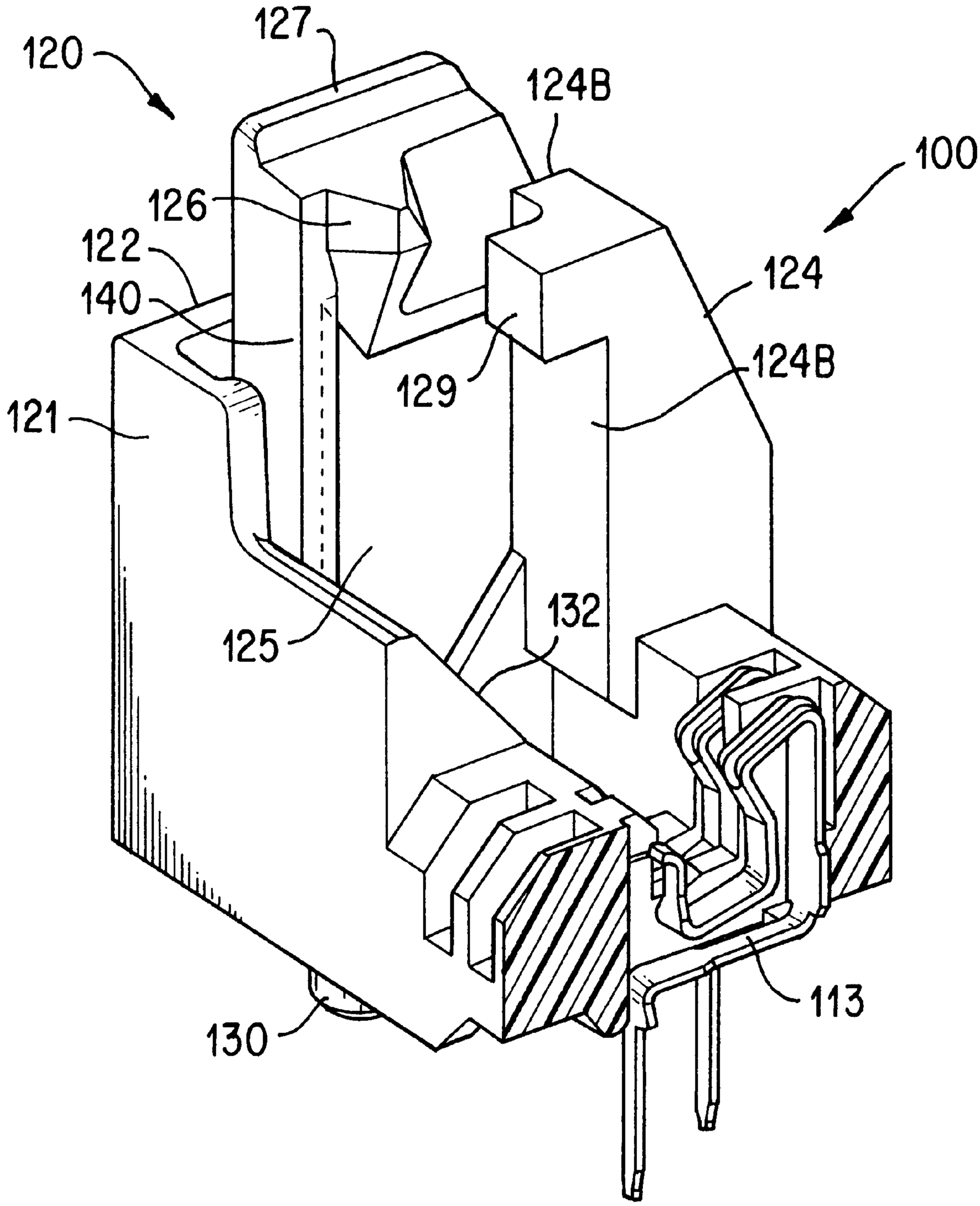

FIG. 5

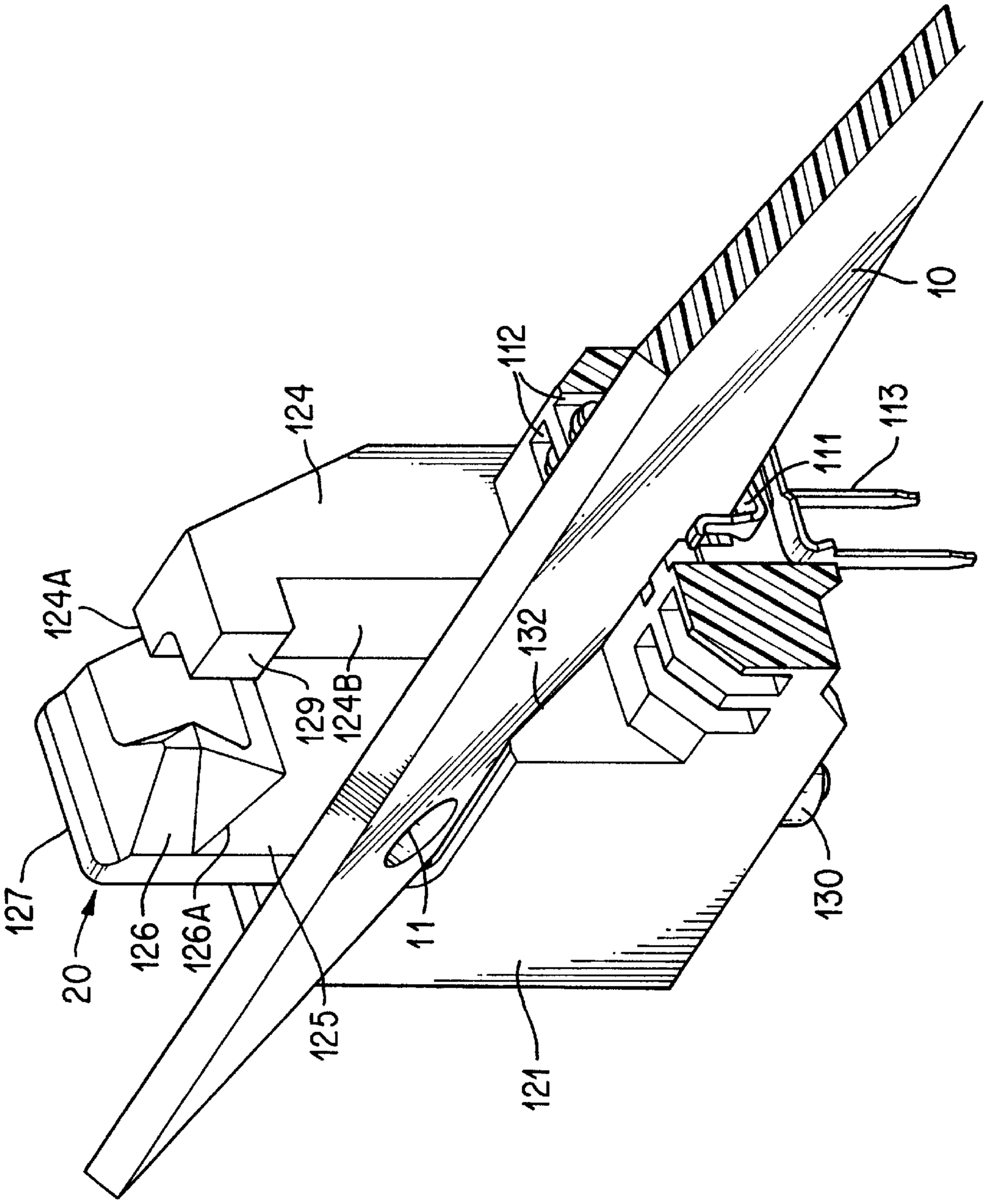
124
112
10
113
111
124A
129
124B
132
127
126
126A
20
11
130
125
121

FIG.6

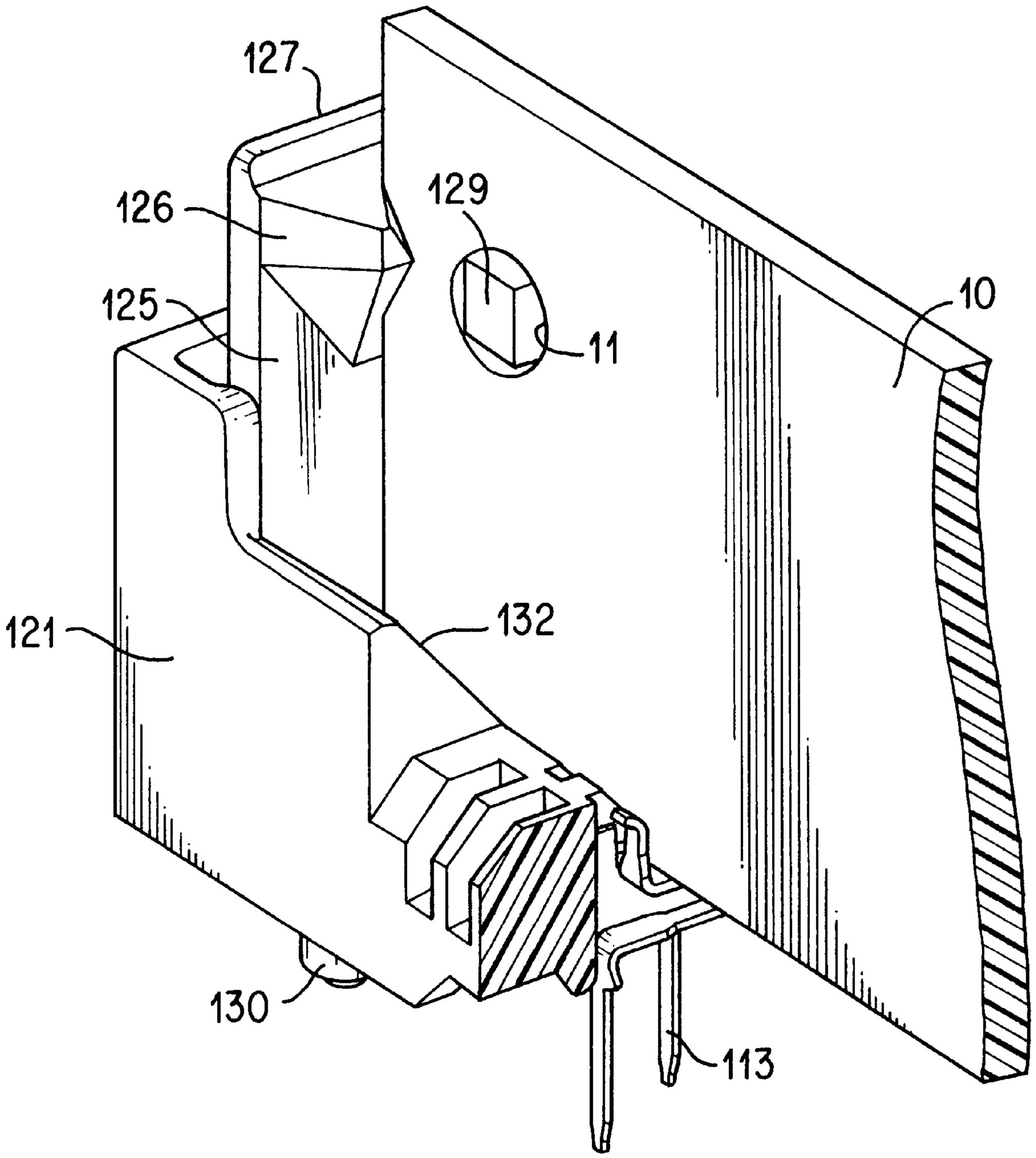

FIG. 7

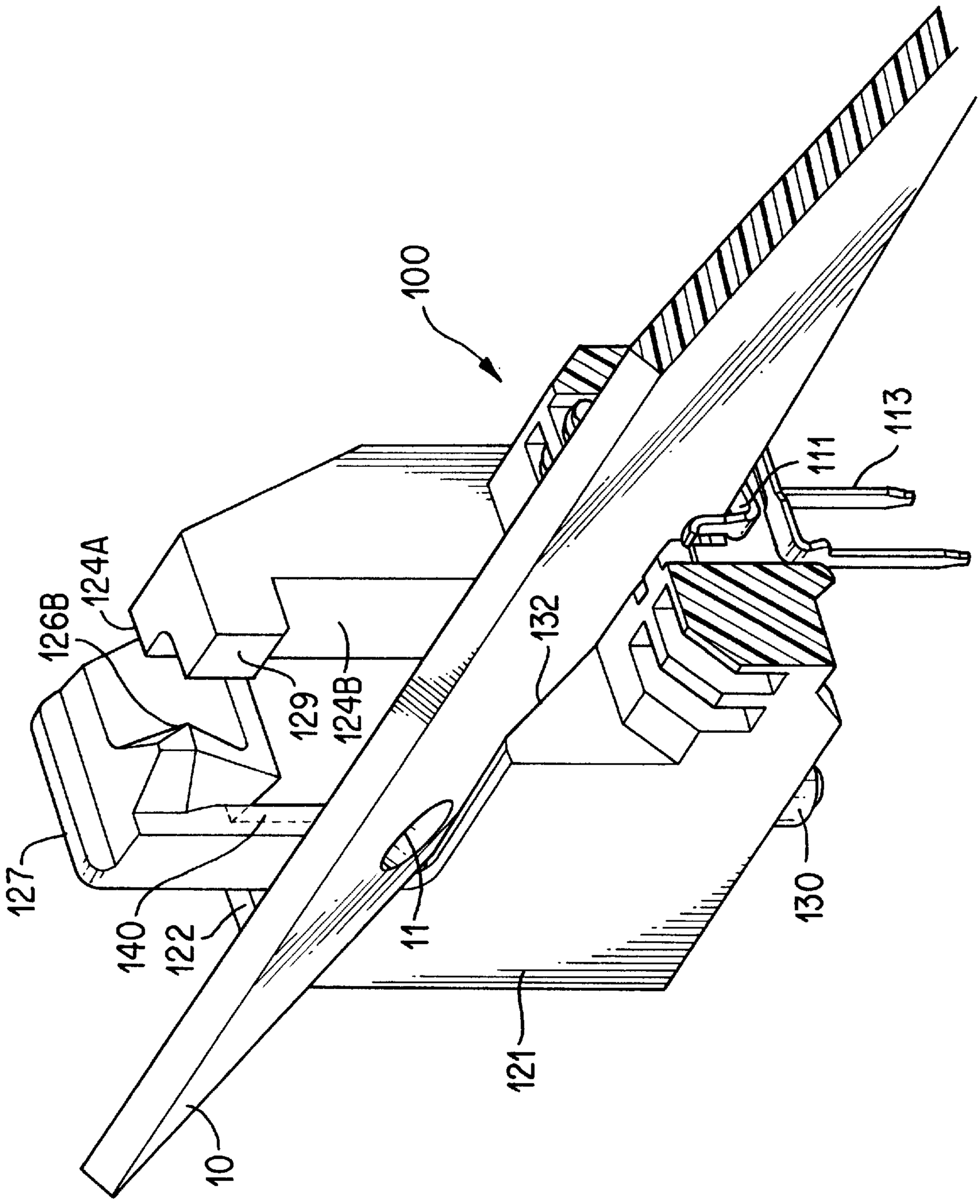

FIG. 8

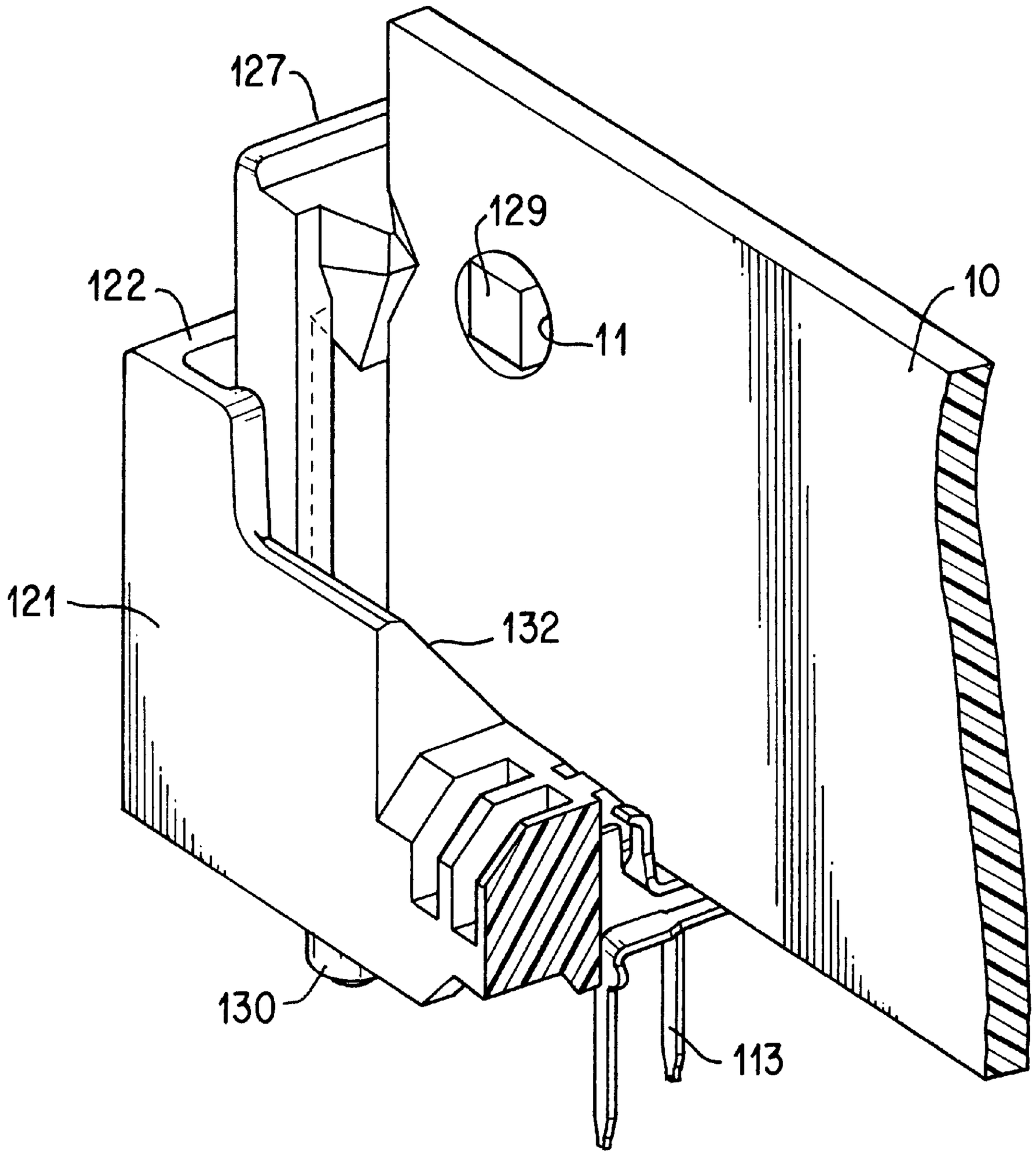

FIG. 9

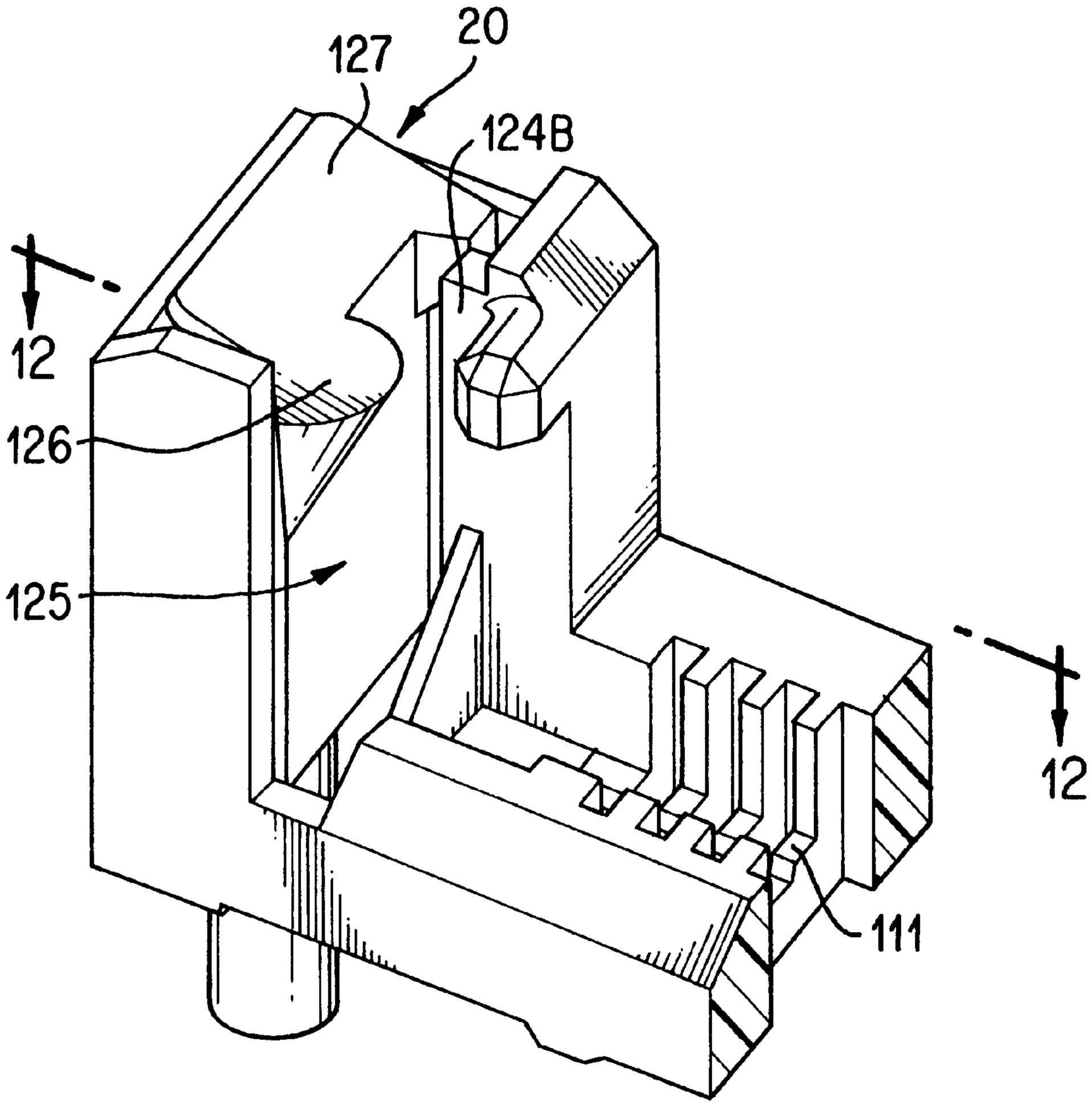

FIG. 10
PRIOR ART

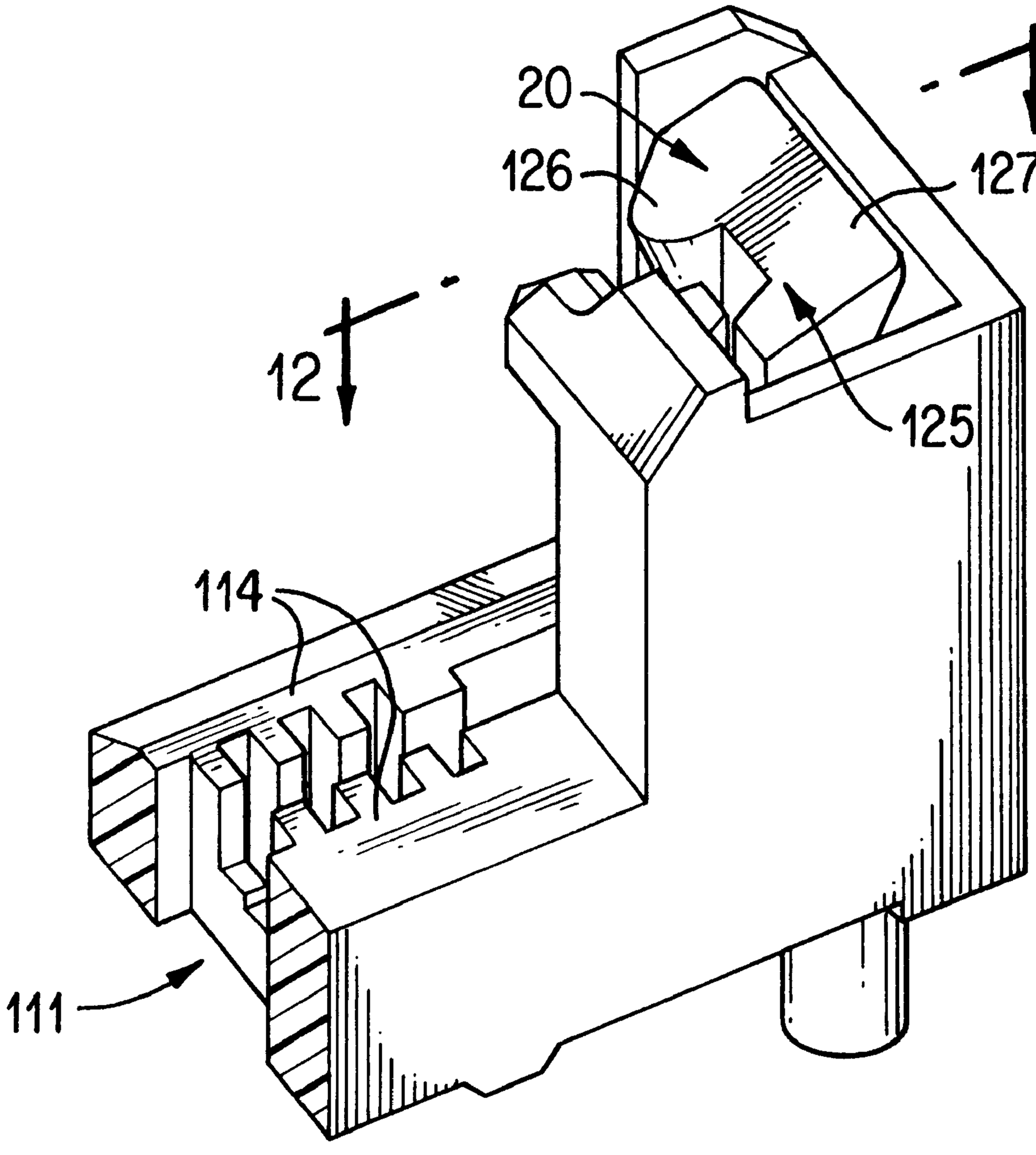

FIG. 11
PRIOR ART

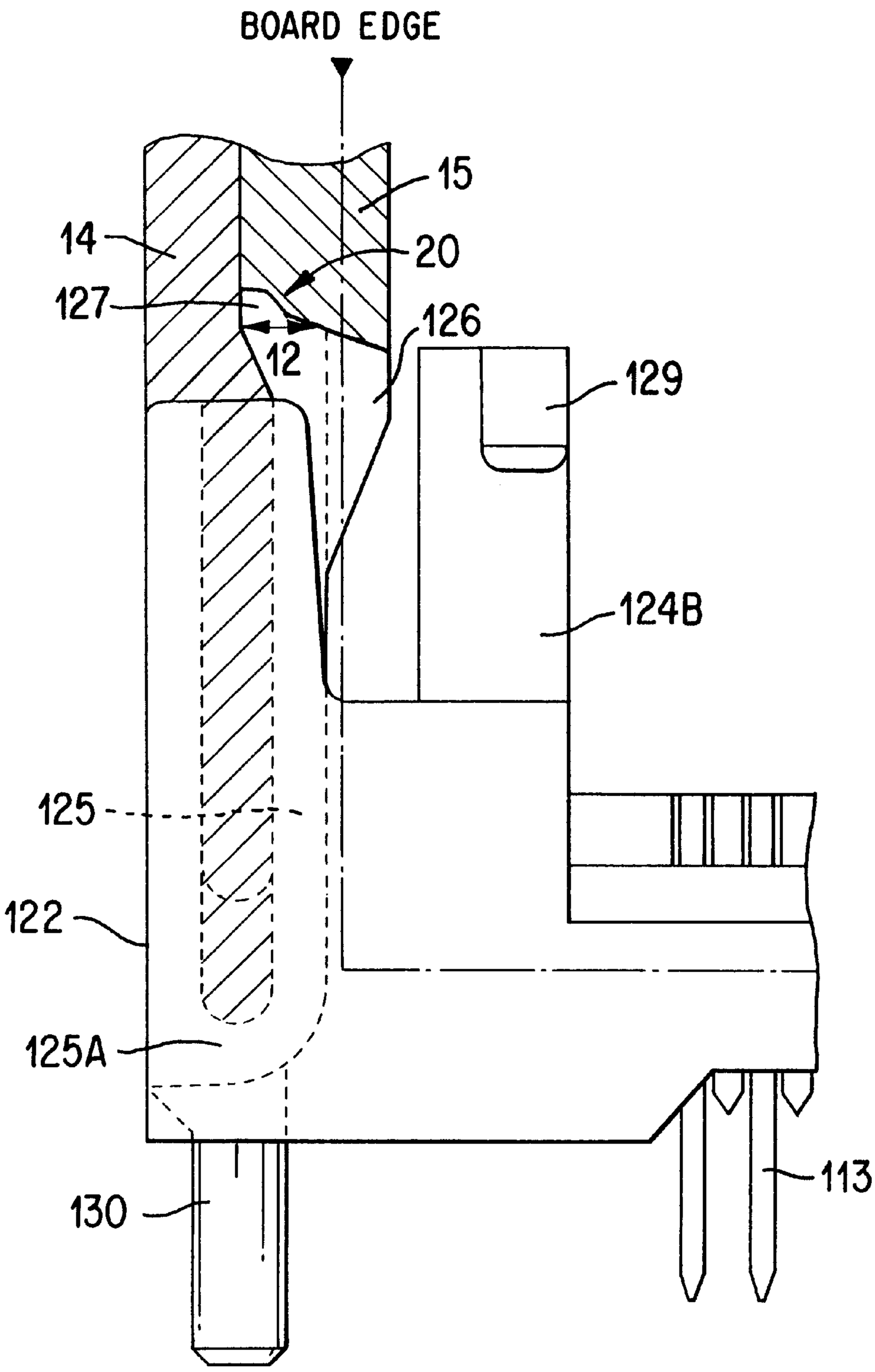

FIG. 12
PRIOR ART

ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to electrical connectors having a board latch and methods for making them and, more particularly, to improvements in the board latch and a method for making the board latch.

2. Description of the Related Art

U.S. Pat. 4,850,892 and Japanese patent application Kokai No. 272796/95 disclose electrical connectors of this type. FIGS. **10** and **11** show an electrical connector such as shown in JP '796. FIG. **10** shows the left side portion of an insulation housing for the electrical connector and FIG. **11** shows the same portion viewed from the back.

The insulation housing of the electrical connector is provided with a board receiving slot **111** extending in the longitudinal direction of the insulation housing. A plurality of contact terminals (not shown) are arranged in the board receiving slot **111** for electrical connection with pads provided on the front edge of a board which is to be inserted into the board receiving slot **111**.

A pair of engaging arms **125** and a pair of abutment walls **124**B are provided at opposite ends of the board receiving slot **111**. The engaging arms **125** extend upwardly from the bottom wall of the insulation housing, and the upper free ends are flexible in the longitudinal direction and are provided with latch knobs **20** having latch hooks **126**.

To connect a board to the electrical connector, the board is inserted obliquely into the board receiving slot **111**. The contact force between the contact terminals and the pads on the front edge is made substantially zero, providing the so-called "zero-insertion-force" structure. Then, the board is rotated toward the abutment walls of the insulation housing. However, there is no positioning device for guiding the front edge of the board to the board receiving slot. As the board is further rotated, its side edges hit the hooks **126** of the engaging arms **125**, flexing the engaging arms **125** outwardly in the longitudinal direction. As a result, the board passes the hooks **126** of the engaging arms **125** and, as soon as its back side hits against the abutment walls **124**B, the engaging arms **125** snap back to the original positions so that the hooks hold the board in place. Under this condition, the pads of the front edge are brought into contact with the contact terminals arranged in the board receiving slot **111**. In such a connection state, the side edges of the board are latched between the abutment walls **124**B and the hooks **126** of the engaging arms.

To remove the board from the electrical connector, the knobs **20** of the engaging arms **125** are pushed outwardly to allow the board to rotate and pass the hooks **126** of the engaging arms **125** so that the board is removable from the board receiving slot. The pulling-it-out force is also substantially zero.

FIG. **12** shows the left side portion of a conventional insulation housing having such functions as described above. This figure does not accurately correspond to FIGS. **10** and **11** but shows a view taken along line **12—12** of FIGS. **10** and **11**.

As evident from this figure, an upward portion of the engaging arm **125** is made substantially flat. However, a projection **127** is provided on the knob **20** so that the engaging arm **125** projects outwardly at its free end. In order to make such a knob **20** it is necessary to use a movable mold consisting of at least two dies **14** and **15** and a fixed mold.

Especially, the shape of the die **14** is complicated to make the projection of the knob **20**. The width of the die **15** is substantially constant along the knob **20**, whereas the die **14** has an undercut portion under the projection.

It is necessary to remove these dies upwardly. The biting or sticking power of a resin to core pins of the die for making apertures to retain contact terminals **113** is higher than the sticking power to the engaging arms or abutment walls so that an undercut portion is provided on the upper face **114** of the housing so that the molded insulation housing sticks to the movable mold. Then, the mold insulation housing is removed from the movable mold. The die **15** is removable independently of the die **14**, but it is impossible to remove the die **14** before the die **15** because the die **14** has the undercut portion. That is, the die **14** is removed after the die **15** is removed, and the upper end of the engaging arm **125** is flexed inwardly in the longitudinal direction. Where the mold has an undercut portion, it is necessary to provide the mold with such a sequence structure. In addition, to stick to the upper face, the mold must have an undercut portion on the upper face of a housing.

Since the conventional device has a projection on the knob or a portion of the engaging arm projecting outwardly, the mold for making the engaging arm has an undercut portion. To remove the undercut mold, it is necessary to provide the movable mold with the sequence structure, making the mold complicated, resulting in the increased manufacturing costs and the decreased life of the mold owing to damage or wear. The sequence structure requires more process steps than the ordinary molding, making the molding cycle longer than before. In addition, parts biting takes place at the undercut portion or projection on the core pin side, and barr are produced at faces of mold parts, thus restricting the molding conditions. Moreover, the core pins are complicated so that the molded insulation housing sticks to the movable mold and is removed by force, thus making burrs on the insulation housing.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the invention to provide an economical electrical connector able to provide a latch knob without using the undercut portion and lowering the maneuverability of the engaging arm.

When a board is inserted into the board receiving slot and rotated to the latch position, there is a considerable gap between the board and the engaging arms. This gap offsets the board from the contact terminals in the board receiving slot, making positioning of the board difficult. When the board is rotated to the latch position, there is too much play so that the contact terminals in the insulation housing do not accurately correspond to the terminals of the board.

Accordingly, it is another object of the invention to provide an electrical connector able to position accurately a board in the electrical connector.

According to one aspect of the invention there is provided an electrical connector, which include an insulation housing with an elongated central section and at lease one side wall extending upwardly at an end of the central section; a board receiving slot provided in the central section to extend in a longitudinal direction of the central section; a plurality of contact terminals arranged in the board receiving slot; at least one board latch extending upwardly from an end of the board receiving slot for latching a side edge of a board inserted into the board receiving slot such that pads of the board are brought into contact with the contact terminals, the board latch comprising: an L-shaped engaging arm extend-

ing laterally from the a joint with side wall and then upwardly to form a vertical portion with a free end so that an outside face of the free end is flush with an outside face of the vertical portion and that the engaging arm is flexible in the longitudinal direction; a hook portion provided on the free end; and an abutment wall cooperating the hook portion for holding a side edge of the board between them.

According to another aspect of the invention there is provided a method for making such an electrical connector with a single metal mold.

According to an embodiment of the invention, a ridge is provided on the engaging arm so as to position accurately the board in the longitudinal direction into the board receiving slot.

According to another aspect of the invention, the ridge extends from a lower end to an upper end of the vertical portion of the engaging arm so as to guide and position the board. The ridge is rounded or tapered to facilitate guiding the board.

Also, the ridge is spaced from the side edge of the board with a gap which is sufficiently small to position accurately the board without play but sufficiently large to slide the board without difficulty.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the left side portion of an electrical connector according to an embodiment of the invention;

FIG. **2** is a perspective view of the portion viewed from the back;

FIG. **3** is a section view of the electrical connector of FIG. **1** cut at the center;

FIG. **4** is a sectional view taken along line **4**—**4** of FIGS. **1** and **2**;

FIG. **5** is a perspective view of an electrical connector according to another embodiment of the invention;

FIG. **6** is a perspective view of the electrical connector of FIG. **1** to which a board is been connected;

FIG. **7** is a perspective view of the electrical connector of FIG. **1** to which the board has been connected;

FIG. **8** is a perspective view of the electrical connector of FIG. **5** to which a board is being connected;

FIG. **9** is a perspective view of the electrical connector of FIG. **5** to which the board has been connected;

FIG. **10** is a perspective view of a conventional electrical connector having a board latching section;

FIG. **11** is a perspective view of the conventional electrical connector viewed from the back;

FIG. **12** is a sectional view taken along line **12**—**12** of FIGS. **10** and **11**, together with the mold.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIGS. **1–5**, an insulation housing **100** has a board receiving slot **111** extending in the longitudinal direction of the insulation housing **100**. A plurality of terminal receiving grooves **112** are provided in the inner face of the board receiving slot **111** for receiving a plurality of contact terminals **113**.

A board latch **120** is provided at a left side end of the insulation housing **100**. Although it is not shown, a board latch identical with the board latch **120** is provided at a right side end of the insulation housing. The insulation housing is molded from an insulation material, such as a plastic, to provide a central section **110** having the board receiving slot **111** and the left and right board latches **120**. A pair of guiding slopes **132** are provided between the central section **110** and the board latches **120** for guiding a board at a predetermined angle.

Each board latch **120** consists of an engaging arm **125**, and a front wall **121**, side wall **122**, and a rear wall **123** surrounding the engaging arm **125**, and a forwardly projecting wall **124**. The distance between opposite ends of the front walls **121** is made slightly larger than the width of a board so as to position the board for insertion and rotation with little play. The opposite ends are rounded or slanted. A projected wall **124**A extends from the forward projecting wall **124** to the engaging arm **125**. An abutment face **124**B is made of the front face of the projected wall **124**A to produce such an effect as described hereinafter. A board positioning projection **129** is provided at the upper portion of the front face of the forwardly projecting wall **124** to produce such an effect as described hereinafter.

The engaging arm **125** extends inwardly from the lower end of the side wall **122** and then upwardly, forming a substantially L-shaped structure. A knob **20** is provided on the upper free end, and a projection **127** is provided on the upper end of the knob **20**. A hook portion **126** is provided on the front face of the projection **127** to produce such a function as described hereinafter. The engaging arm **125** is flexed outwardly by pushing the projection **127** outwardly. The engaging arm **125**, however, is protected against excessive flexure by the front wall **121**, the side wall **122**, the rear wall **123**, and the forwardly projecting wall **124** which surround the engaging arm **125** except the vicinity of the hook portion **126**.

Unlike the conventional device of FIG. **12**, the knob **20** of the engaging arm **125** does not extend outwardly but upwardly from the engaging arm **125**, with the outside surface flush with that of the engaging arm **125**. However, the widths **12** (FIGS. **4** and **12**) of the knob **20** and the vertical portion of the engaging arm **125** are made the same as the conventional ones to maintain the maneuverability. Consequently, the engaging arm **125** is shifted outwardly by a degree equal to the projection of the conventional knob. This outward shift of the engaging arm **125** reduces the distance between the side wall **122** and the engaging arm **125** so that it is difficult to flex the engaging arm **125** outwardly. In order to solve such a problem, the side wall **122** is made shorter than the conventional one. For example, the height of the side wall **122** is on a level with the lower end of the hook portion **126**.

The thickness of the engaging arm **125** gradually decreases from the side wall **122** to the free end so that when the engaging arm is flexed, the surface stress is distributed evenly at each point of the engaging arm. The joint between the engaging arm **125** and the side wall **122** is lower than the bottom of the board receiving slot **111** so as to provide the engaging arm **125** with high flexibility within the limited height of the insulation housing.

The shape of a metal mold for forming the knob **20** is shown by hatching **16** in FIG. **4**. The knob **20** does not project outwardly but is flush with the vertical portion of the engaging arm so that the metal mold **16** has a corresponding flat surface. Consequently, it is not necessary to provide the metal mold **16** with the sequence structure and to make two mold halves but it is possible to make a single metal mold which is removable in one direction.

Another embodiment of the invention is shown in FIG. **5**, wherein an improvement is made to the engaging arm. In the

conventional device and the device of FIGS. **1–4**, it is difficult to position a board accurately because of a gap between the side edge of a board (shown by broken line in FIG. **4**) and the inside face **132** of the engaging arm **125**. Especially, where the engaging arm **125** is shifted outwardly, the gap increases, making the problem worse. A ridge **140** is provided on the vertical portion of the engaging arm **125** to facilitate the positioning of a board upon insertion and rotation. The gap between the ridge **140** and the side edge of a board is sufficiently small to prevent play but sufficient large to allow smooth insertion of a board. The ridge **140** is provided at such a position as to abut the side edge of a board upon insertion and has a sufficient length to position the board. For example, it extends from the lower end to the upper end of the vertical portion of the engaging arm **125**. The face of the ridge **140** to guide the side edge of a board may be rounded or papered to facilitate the insertion or rotation.

A fixing stud **130** extend downwardly from the lower face of the insulation housing **100** to position the insulation housing **100** on a printed circuit board (not shown) for mounting. The fixing stud **130** is molded integrally with the board latch **120** so as to increase the strength of the engaging arm **125**.

The horizontal portion **125**A of the L-shaped engaging arm **125** is joined with the lower end of the side wall **122**. A gap (not shown) is provided between the horizontal portion **125**A and the fixing stud **130** so that the free end of the engaging arm **125** flexes in not only the longitudinal direction but also the lateral direction of the insulation housing. Also, it is sufficiently flexible to be twisted as described in Japanese patent application Kokai No. 272796/95.

How to insert a board to the electrical connector will be described with reference to FIGS. **6** and **7**, wherein a board is inserted and latched, respectively.

As shown in FIG. **6**, a board **10** is inserted into the board receiving slot **111** of the central section **110** at an angle, for example, about 30° with respect to the vertical line such that the pads on the board **10** correspond to the contact terminals **113** in the board receiving slot **111**. Then, the board **10** is rotated toward the abutment wall **124**B of the board latch **120** against the spring force of the contact terminals **113**.

When the board **10** is further rotated, it pushes the cam face **126**A of the hook portion **126** so that the engaging arm **125** is flexed outwardly at the joint with the side wall **122**, and the hook portion **126** is moved outwardly. Consequently, the board **10** passes the hook portion **126** and abuts against the abutment wall **124**B. Then, the engaging arm **125** is returned to the original position so that the retaining faces **126**B of the hook portions **126** snap the board **10** at opposite side edges, with the positioning hole **11** of the board **10** fitted over the positioning projection **129** of the board latch **120**. The positioning projection **129** does not fitted into the positioning hole **11** when the board front edge is not correctly received by the board receiving slot. The size, shape, and position of the positioning projection **129** depends on the positioning, maneuverability, and insertion error preventing function. Such conditions are shown in FIG. **7**.

Under the conditions of FIG. **7**, the board **10** is latched to the insulation housing **100** between the abutment wall **124**B of the board larch **120** and the retaining face **126**B of the hook portion **126** so as to bring the pads of the board **10** into contact with the contact terminals in the board receiving slot **111**.

To release the board **10** from the latch conditions of FIG. **7**, the projections **127** of the engaging arms **125** are pushed outwardly so as to flex the engaging arms **125** outwardly to release the retaining faces **126**B of the hook portions **126** from the side edges of the board. The board **10** is rotated by the bias of the contact terminals **113** in the board receiving slot **111** toward the position in FIG. **6**. Now, the board **10** is removable from the board receiving slot **111**. Upon removal, the contact force of the contact terminals to the board **10** is substantially zero as the zero-insertion-force connector, and a very small pulling force is required to remove the board.

The operation of the ridge **140** is shown in FIGS. **8** and **9**. The basic operation, however, is the same as above in FIGS. **6** and **7**. In FIG. **8**, the left edge of the board **10** is positioned by the ridge **140** of the engaging arm **125** so that the pads (not shown) of the board **10** correspond to the contact terminals **113** in the board receiving slot **111**. When the board **10** is rotated, it is guided by the ridge **140** so that there is no play but the rotation is very smooth. When the board is latched as shown in FIG. **9**, the pads of the board **10** correspond accurately to the contact terminals **112** in the board receiving slot **111**

The L-shaped engaging arm is surrounded by the walls for protection from excessive load in the above embodiment but, in place of the walls, hook mechanisms may be provided to restrict the flexure in every direction of the engaging arm.

As has been described above, according to the invention, the undercut portion of a metal mold for forming the engaging arm is eliminated so that the metal mold is simplified. Consequently, there is neither sequence structure nor sliding parts required so that parts biting is eliminated. The costs of maintenance and manufacturing of the metal mold are reduced and the molding cycle is shortened. Since the resin bites or sticks to the movable metal mold or the core pins for forming holes to fix the contact terminals, it is not necessary to make an undercut portion for removing the insulation housing. Consequently, fewer burrs are made, and the cost for making the metal mold is reduced.

Thus, it is possible to make the board latch with a knob without lowering the maneuverability of the engaging arm and the use of an undercut portion.

In addition, the ridge on the engaging arm positions and guides accurately a board into the board receiving slot. Consequently, the pads of the board accurately correspond to the contact terminals without play. Since it is guided by the ridge, the board is connected to the electrical connector with ease.

What is claimed is:

1. An electrical connector, comprising:

an insulation housing with an elongated central section and at least one side wall extending upwardly at an end of said central section;

a board receiving slot provided in said central section to extend in longitudinal direction of said central section;

a plurality of contact terminals arranged in said board receiving slot;

at least one board latch extending upwardly from an end of said board receiving slot for latching a side edges of said board inserted into said board receiving slot such that pads of said board are brought into contact with said contact terminals, said board latch comprising:

an L-shaped engaging arm extending laterally from a joint with said side wall and then upwardly to form a vertical portion with a free end so that an outside face of said free end is flush with an outside face of said vertical portion thereby eliminating an undercut portion of metal mold;

a hook portion provided on an inside face of said free end; and

an abutment wall cooperating said hook portion for holding side edge of said board between said hook portion and said abutment wall.

2. An electrical connector according to claim **1**, wherein said side wall has a height lower than a lower end of said hook portion.

3. An electrical connector according to claim **1** or **2**, wherein said joint with said engaging arm is lower than a lower face of said board receiving slot.

4. An electrical connector according to claim **1** or **2**, wherein said engaging arm has a thickness which gradually decreases in said longitudinal direction from said joint to said free end so that a surface tension is distributed evenly at each point of said engaging arm upon flexing.

5. An electrical connector according to claim **1** or **2**, which further comprises flexure restricting means for surrounding said free end except said hook portion to restrict flexure of said engaging arm in different directions.

6. An electrical connector according to claim **1** or **2**, which further comprises a projection provided on said fee end to enhance maneuverability of said engaging arm.

7. An electrical connector according to claim **1** or **2**, which further comprises a fixing stud molded integrally with said engaging arm.

8. An electrical connector according to claim **1** or **2**, which further comprises a ridge provided on said engaging arm so as to position said board in said longitudinal direction into said board receiving slot.

9. An electrical connector according to claim **8**, wherein said ridge extends from a lower end to an upper end of said vertical portion of said engaging arm so as to guide and position said board.

10. An electrical connector according to claim **9**, wherein said ridge is spaced from said side edge of said board with a gap which is sufficiently small to position accurately said board without play but sufficiently large to slide said board without difficulty.

11. An electrical connector according to claim **9**, wherein said ridge is rounded or tapered.

12. A method for making an electrical connector according to claim **1**, wherein said side wall and said engaging arm are molded with a single metal mold.

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